SACRAMENTO REGIONAL WASTEWATER TREATMENT PLANT
NPDES PERMIT RENEWAL

TESTIMONY/COMMENTS OF CLAUS SUVERKROPP
of LARRY WALKER ASSOCIATES
Regarding
STATISTICAL ANALYSIS OF THE POTENTIAL ROLES OF AMMONIA AND
NUTRIENT RATIOS IN THE UPPER SAN FRANCISCO ESTUARY

On behalf of the

SACRAMENTO REGIONAL COUNTY SANITATION DISTRICT

I am Claus Suverkropp. I am an Associate with Larry Walker Associates, an environmental science and engineering firm based in Davis, CA. I am an environmental scientist with over 20 years of experience in evaluating and analyzing monitoring data, assessing water quality, conducting integrative data analysis, and evaluating regulatory issues relating to surface water quality. My education includes a Master of Science degree in Animal Science from the University of California at Davis. At Larry Walker Associates, my professional experience includes analysis of receiving water, agricultural runoff and return flows, stormwater, wastewater, and sediment monitoring data, analysis of toxicity bioassay data, and water quality and beneficial use assessment studies. My data analysis experience includes a wide range of simple and advanced parametric and non-parametric statistical methods, statistical and probabilistic water quality modeling and data analysis. A copy of my resume describing my education and experience is attached.

**Findings Regarding the Statistical Analysis Supporting the Potential Role of Ammonia and Nutrient Ratios in the San Francisco Estuary**

I contributed to comments regarding the statistical methods used by the publication cited in the Tentative NPDES Permit for the Sacramento Regional Wastewater Treatment Plant that hypothesized that changes in N:P or ammonia:nitrate ratios are responsible for the observed shift in the Delta phytoplankton community from an assemblage historically dominated by diatoms to one that is now dominated by flagellates and blue-green algae (Glibert 2010). My analysis of the supporting statistical methods and related conclusions are documented in Engle & Suverkropp (2010). In brief, the statistical methods used in Glibert 2010 were inappropriate for the intended purpose, incorrectly implemented, and inadequately documented. Based on these failings, they do not provide valid scientific support for the author's conclusions. The primary deficiencies relating to those analyses are as follows:

- **The simple CUSUM correlations that represent the basis for the author's conclusions violate virtually every assumption of a standard correlation analysis.** The Glibert paper relies on Cumulative Sum (CUSUM) correlations. In statistical quality control, the CUSUM is a sequential analysis technique based on

calculation of the cumulative sums of a series of measurements. It is typically used for detecting changes in a process or measurement system. It is not commonly used for analyzing causative or correlative relationships between parameters. CUSUM series are inherently serially correlated, heteroscedastic, and non-normally distributed. The residuals of a correlation analysis with CUSUM data are also serially correlated, not independent, and are non-normally distributed. The method of CUSUM correlation analysis used in the Glibert paper violates the underlying assumptions for linear regression and consequently provides invalid and misleading conclusions. To sum up, accepted statistical practice does not permit the use of CUSUM series in correlation or regression analysis in the way used by the author, and conclusions based on this method are scientifically invalid.

- **The method of CUSUM correlation analysis results in artificial relationships and inflated correlation values.** Because of the nature of CUSUM data series, real trends or patterns in the data are obscured or inverted, and periods with no trend can produce a series of increasing or decreasing CUSUM values, depending on the relationship between the actual measurements and the population mean and where they occur in the longer time series. This can generate artificial patterns in the CUSUM data and correlations that are not supported by the underlying data. Another result of these limitations of CUSUM data structure is that it generates "correlations" with impressively inflated $R^2$ values that are largely artificial and cannot be interpreted in the same way as for standard parametric correlation or regression analysis. Consequently, the CUSUM transformation can generate apparently statistically significant relationships between independent and dependent variables for which no relationship can be derived using the underlying real-world data, leading to invalid conclusions about the underlying relationships.

- **Statistical methods were insufficiently documented.** A requirement of standard CUSUM analysis is that time series being compared using CUSUM must start and stop at the same point in time. Data series do not have to have the same number of observations, but the CUSUM series must be generated for the same time period for each variable. If variables cover different but overlapping time periods, valid comparisons of trends in two factors must be made with CUSUM series calculated only for the common overlapping period. It is not specified whether CUSUM series were appropriately recalculated for each correlation analysis. If this was not done, the comparisons are meaningless. Additionally, the author also does not document how raw data or CUSUM values measured monthly were aggregated to compare them with annual abundance indices. The lack of adequate documentation prevents replication or validation of the analysis and is commonly required for scientific publication and review.

The comments related to statistical analyses provided in Section II (Nitrification) of comments being submitted by Sacramento Regional County Sanitation District accurately reflect my evaluations, conclusions, and opinions.

# References

Engle, D. and C. Suverkropp. 2010. Memorandum: Comments for Consideration by the State Water Resources Control Board Regarding the Scientific Article *Long-term Changes in Nutrient Loading and Stoichiometry and their Relationships with Changes in the Food Web and Dominant Pelagic Fish Species in the San Francisco Estuary, California* by Patricia Glibert. 17 pp. July 29, 2010.

Glibert. P. M. 2010. Long-term changes in nutrient loading and stoichiometry and their relationships with changes in the food web and dominant pelagic fish species in the San Francisco Estuary, California. Reviews in Fisheries Science 18(2): 211-232.

## Education

M.S. Animal
Science, 1990,
University of
California, Davis

B.A. Aquatic
Biology, 1981,
University of
California, Santa
Barbara

## Years of
## Experience
21

## Professional
## Affiliations

Member, Society of
Environmental
Toxicology and
Chemistry

Mr. Suverkropp is an Associate with Larry Walker Associates specializing in monitoring, assessment of water quality, integrative data analysis, and regulatory issues. His professional experience includes analysis of receiving water, agricultural runoff and return flows, stormwater, wastewater, and sediment monitoring data, analysis of toxicity bioassay data, and water quality and beneficial use assessment studies. His work includes evaluation of site-specific and cumulative environmental impacts, regulatory compliance, and significance of proposed regulation. In addition, Mr. Suverkropp plans and designs studies to develop site-specific water-quality objectives. His data analysis experience includes parametric and non-parametric statistical methods, statistical water quality modeling, and assessment of sensitive ecosystem indicators.

## RELEVANT EXPERIENCE AT LARRY WALKER ASSOCIATES

### Water Management/Permitting

#### Sacramento Valley Water Quality Coalition (SVWQC)

Responsible for overall management and coordination. Prepared and reviewed the Coalition's initial Monitoring and Reporting Program Plan (MRPP) for the Irrigated Lands Regulatory Program (ILRP). Negotiated development of the current ILRP Monitoring and Reporting Program (MRP) with the Water Board and maintained the Quality Assurance Project Plan consistent with the goals of the MRP and requirements of the Central Valley Regional Water Quality Control Board's ILRP and SWAMP. Responsibilities include development of monitoring plans, oversight and coordination of data management, compliance evaluations, and communication of results to Coalition subwatersheds and Water Board ILRP staff, and preparation of semi-annual Monitoring Reports. Also developed the Water Quality Management Plan to address water quality problems identified by SVWQC monitoring. Conducted source evaluations integrating monitoring data, pesticide use data, and toxicity and chemical characteristics of pesticides. Provides additional program support through evaluation of potential causes of exceedances, assists with Coalition outreach efforts, and is an active participant in several Regional Board committees to direct and improve the Irrigated Lands Regulatory Program.

#### Central Coast Coordinated Monitoring Program, Central Coast Water Quality Preservation, Incorporated (CCWQP)

Responsible for overall management of water quality and sediment monitoring for the CCWQP Conditional Waiver monitoring program. Responsibilities include oversight and coordination of data management, compliance evaluations, communication of results to the CCWQP Monitoring Committee, and preparation of quarterly data reports to CCWQP. Provided additional program support through participation in grower outreach efforts. Prepared the Water Quality Report for CCWQP's Proposition 50 Grant to report and evaluate monitoring data, including assessment of compliance with water quality objectives, analysis of seasonal and spatial patterns, and relationships between biological integrity, habitat, and water quality.

#### Caltrans Discharge Characterization Study Report (DCSR) and Update

Responsible for conducting in-depth statistical studies to achieve a number of specific objectives of the California Department of Transportation (Caltrans). The initial Statewide Characterization Study Report (DCSR) systematically characterized representative sites for each of the Department's major transportation facility types and

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analysis of the factors affecting the quality of runoff. The analysis focused on data from a three-year statewide study designed to be representative of transportation facilities throughout the state. The monitoring data evaluated also include the results of other Caltrans studies conducted prior to or in parallel with the statewide study. The principal statistical methods used to achieve the objectives of this report were Multiple Linear Regression (MLR), Analysis of Variance (ANOVA), and Analysis of Covariance (ANCOVA). Relationships between pollutants in runoff were also evaluated using non-parametric correlation methods. The update includes analysis of new data and conclusions relevant to additional investigation and management of stormwater runoff from transportation facilities to address the following specific objectives using data generated from Statewide Stormwater Runoff Characterization monitoring of highway facilities from 1997 to 2007:

- Identify significant regional differences in runoff quality.

- Identify sites with atypical concentrations of pollutants (high or low "hot spots") for additional evaluation of site-specific factors affecting runoff quality.

- Determine whether there are within-storm patterns in runoff quality relevant to specific management options.

- Investigate whether other external site-specific and event-specific factors affect runoff quality.

Sacramento River Watershed Program, Sacramento Regional County Sanitation District

Responsible for managing, coordinating, and implementing the monitoring effort for the program. Authored the Quality Assurance Project Plan (QAPP), reviewed and evaluated Quality Assurance data, and assisted with design and management of environmental quality database. Instrumental in reviewing, supporting, and developing annual monitoring plans through the SRWP stakeholder-driven Committee process.

Sacramento River Watershed Program, Proposition 50 CALFED Watershed Program Grant

Responsible for managing, coordinating, and implementing the monitoring effort for the program. Authored the Quality Assurance Project Plan (QAPP), reviewed and evaluated Quality Assurance data, and designed and maintained project-specific environmental quality database system. Developed and prepared the final monitoring report for the Sacramento River Watershed Program (SRWP) Prop 50 Grant project. This document reviewed of the Sacramento River Watershed Program (SRWP) monitoring effort and integrated data collected by the SRWP and coordinating programs. Water chemistry, aquatic toxicity, and fish tissue data were used to evaluate the attainment of beneficial uses and potential impairment of surface waters of the Sacramento River Watershed (watershed) and to assess spatial and temporal distributions of a variety of important water quality characteristics.

Sacramento Coordinated Water Quality Monitoring Program, County and City of Sacramento

Responsible for review and development of ongoing Ambient Monitoring Program methods, including design and implementation of special studies to assess effectiveness of sampling and analytical protocols. Coordinated with program manager and field sampling crew as well as reviewed and evaluated water quality and QA/QC data, tracked laboratory performance, and identified special sampling and analytical requirements. In

addition, Mr. Suverkropp handled extensive data analyses to assess regulatory compliance, water quality impacts, and monitoring effectiveness.

Ventura County Stormwater Quality Management Program

Responsible for Quality Assurance/Quality Control evaluations for stormwater monitoring data collected by NPDES permittees. Performed analyses to assess stormwater quality, compatibility of monitoring sites, and suitability of monitoring data for mass loading estimates and stormwater quality modeling.

Bay Area Dischargers Association

Responsible for technical review of site-specific objectives developed by the San Francisco Regional Water Quality Control Board for the San Francisco Bay Region. Evaluated ability of POTWs to attain site-specific objectives for the San Francisco Bay.

Sacramento River Mercury Control Planning Project, Sacramento Regional County Sanitation District

Responsible for statistical analyses and modeling of mercury loading in the Sacramento River watershed, management of environmental data base, evaluation and selection of alternative mercury control strategies, preparation of technical reports, and presentation of results.

## RELEVANT EXPERIENCE PRIOR TO LARRY WALKER ASSOCIATES

School of Veterinary Medicine, Depts. of Anatomy, Pharmacology and Toxicology, University of California, Davis

Assessed effects of toxic compounds designed and modified experimental protocols, biochemical analyses for toxicant metabolites, and analyses of histopathology data. Developed novel techniques for explant culture of bronchiolar tissue.

Massachusetts Audubon Society, Gloucester, Massachusetts

Monitored and analyzed water quality in Gloucester. Assessed impacts of sediment composition on bivalve recruitment and production.

Bodega Marine Laboratory, University of California, Davis

Investigated gamete interaction and reproductive physiology of Penaeid shrimp, including development of sperm competency bioassay. Initiated morphological and histological studies of sperm storage in the Penaeid, *Sicyonia ingentis*. Collected, maintained, and assessed the reproductive status and molt stage of experimental animals.

Western Environmental Services Company, Novato, California

Field monitoring and performance of Instream Flow Analysis for Environmental Impact Reports.

## PROFESSIONAL AFFILIATIONS

Member, NorCal Society of Environmental Toxicology and Chemistry